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BASIC PROPERTIES OF MYOSIN HEAD POWER AND RECOVERY STROKES AS REVEALED BY EXPERIMENTS USING THE GAS ENVIRONMENTAL CHAMBER

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Although more than 50 years have passed since the discovery of the sliding filament mechanism in muscle contraction, molecular mechanism of myosin head power and recovery strokes still remains to be a mystery. Using the gas environmental chamber (EC) attached to the transmission electron microscope, we have succeeded in visualizing and recording myosin head power and recovery strokes in individual myosin heads, coupled with ATP hydrolysis. The results hitherto obtained are summarized as follows: (1) In the absence of actin filaments and ATP, myosin heads fluctuate around a definite neutral position, so that time-averaged myosin head position remains unchanged with time; (2) On ATP application, myosin heads move away from, but not towards, the bare region at the center of myosin filaments, indicating myosin heads perform recovery stroke; (3) The average amplitude of the recovery stroke is ~6 nm; (4) In the presence of actin filaments, myosin heads perform power stroke by stretching adjacent elastic structure due to a limited amount of ATP applied; (5) The average amplitude of power stroke is 3.3 nm at the distal region, and 2.5 nm at the proximal region of myosin head catalytic domain; (6) In both power and recovery strokes, myosin heads return to their neutral position after complete exhaustion of ATP applied, indicating that myosin heads (M) can take three definite positions, i.e., neutral, post-power stroke, and post recovery stroke positions, the transition between them is associated with reaction, M-ATP M-ADP-Pi. We emphasize that our EC experiments are extremely promising, if coupled with the methods of laser flash photolysis of caged ATP and time-resolved electron microscopy.

Biography

Haruo Sugi has completed his PhD from the University of Tokyo in 1962, and worked in the University of Tokyo, Columbia University and National Institutes of Health. He was Professor and Chairman in the Department of Physiology, School of Medicine, Teikyo University from 1973 to 2004 and when he became Emeritus Professor, from 1998 to 2008, he was Chairman of Muscle Committee in the International Union of Physiological Sciences (IUPS).

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